

**ITEM 557.630YXX08 – HPIC CONCRETE FOR SUPERSTRUCTURE SLABS AND
STRUCTURAL APPROACH SLAB OR PRE-CAST SLAB
ALTERNATE**

DESCRIPTION

Option 1: Furnish and place reinforcing steel and HPIC concrete to construct superstructure slabs or approach slabs as shown in the contract documents. Then diamond grind the surface.

Option 2: Furnish and place precast concrete deck or approach slabs with ultra high performance concrete (UHPC) joints located as shown in the contract documents. Then diamond grind the surface. The maturity method is preferred over ASTM C39 to estimate the in-place UHPC strength.

For both options:

XX = Friction Type

01 - Type 1 Friction

02 - Type 2 Friction

03 - Type 3 Friction

09 - Type 9 Friction

OPTION 1

MATERIALS

Use materials meeting §557-2, except as noted below:

- 1) Use the reinforcement shown in the Contract Documents.
- 2) If none is shown, then use any of the acceptable reinforcements except Uncoated Steel Reinforcement meeting 709-01 or 709-14.
- 3) AASHTO M 334 steel is also acceptable. ASTM 1035 steel meets AASHTO M334.
- 4) Use HPIC meeting §557-2.03.

CONSTRUCTION DETAILS

Apply the provisions of §557-3 and the following modifications:

Curing shall be as per §557-3.11, except that when either stainless steel or AASHTO M334 steel is used, the curing duration shall be reduced to the greater of 72 hours or when the concrete reaches 3000 psi. All cylinder sets shall be cured in an environment like the material they represent.

Cylinders to determine in-place compressive strength shall be cast in sets of 2 cylinders, 6 inches X 12 inches, for each age for which the concrete is to be tested. Compressive strengths shall be per ASTM C 39. The timing of the testing shall be as needed to open to traffic and as ordered by the Engineer, except that one set of cylinders shall be tested at 28 days. The cylinders will be broken by the Department.

OPENING TO TRAFFIC

The concrete must have a minimum compressive strength of 3000 psi, unless a different strength is shown in the Plans. If the concrete does not achieve the proper strength, contact the Deputy Chief Engineer of Structures.

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OPTION 2 – PRECAST CONCRETE DECK SYSTEM CONSTRUCTION

MATERIALS

PRECAST DECK: Materials used in this work shall conform to the NYSDOT Prestressed Concrete Construction Manual (PCCM)-Current Edition and the following:

CONCRETE

28 Day Compressive Strength 5000 psi (Minimum)

Lifting Strength 2900 psi (Minimum)

Use the reinforcement shown in the Contract Documents. If none is shown:

- 1) Use reinforcement per §556-2 or as noted below but not Uncoated Steel Reinforcement meeting 709-01 or 709-14.
- 2) AASHTO M 334 steel is acceptable. ASTM 1035 steel meets AASHTO M334.
- 3) Mechanical Connectors for reinforcing bars splices 709-10
- 4) Leveling Bolts ASTM F568, Class 4.6

High Weight Methyl Methacrylate (used to prevent leaking joint)

The high molecular weight methacrylate (HMWM) resin shall be low viscosity and non-fuming. Acceptance is based on the manufacturer certifying that it conforms to the following, and the contractor forwarding the certification to the DCES:

Viscosity Less than 25 cps when measured according to ASTM D2849

Density Greater than 8.4 lb/gal. @ 77° F.

Flash Point Greater than 200° F.

Vapor Pressure Less than 1.0 mm Hg @ 77° F. (ASTM D 323)

TG (DSC) Greater than 136° F (ASTM D3418)

Gel Time Greater than 40 minutes for a 100 gram mass

Percent Solids Greater than 90 % by weight

Bond Strength Greater than 1522.3 psi (ASTM C882)

Sand The sand shall be commercial quality dry blast sand. 95% of the sand shall pass the #8 sieve, and 95% shall be retained on the #30 sieve.

The container shall include the following information: The name of the manufacturer, the brand name of the product, the date of manufacture.

UHPC: The material shall be Ultra High Performance Concrete, all components supplied by one manufacturer. Materials commonly used in UHPC are:

Fine aggregate

Cementitious material

Super plasticizer

Accelerator

Steel Fibers

Water shall meet the requirements of §712-01.

UHPC material shall meet the following, 28 days unless otherwise noted:

Minimum Compressive Strength (ASTM C39) ≥ 18 ksi

4 day ≥ 12 ksi

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Prism Flexural Tensile toughness (ASTM C1018**; 10 in. span)	$I_{30} \geq 48$
Long-Term Shrinkage (ASTM C157; initial reading after set)	≤ 800 microstrain
Chloride Ion Penetrability (ASTM C1202)	≤ 250 coulombs
Scaling Resistance (ASTM C672)	$y < 3$
Freeze-Thaw Resistance (ASTM C666A; 600 cycles)	RDM $> 96\%$
Alkali-Silica Reaction (ASTM C1260; tested for 28 days)	Innocuous

Results of all the tests above, conducted by an AASHTO accredited testing lab shall be submitted to the DCES for review and approval a minimum of 60 days prior to the use of UHPC in the field.

Acceptance Testing: Note: acceptance testing will be waived if the same material from the same supplier has already been tested according to this standard. The Contractor shall complete the testing of the UHPC a minimum of three months before placement of the UHPC. The testing sequence will include the submission of a plan for casting and testing procedures to the DCES for review and approval followed by casting and testing according to the approved plan.

Casting and testing must include the following:
A minimum of 12 cylinders 3 in. X 6 in. shall be cast.

All cylinders shall be cured using the same method of curing proposed to be used in the field. The temperature during curing shall be within 18°F of the low end of the proposed temperature range for curing in the field. 2 cylinders shall be tested each testing day. Testing times are at 4 days, 7 days, 14 days, and 28 days. The compressive strength shall be measured by ASTM C39 and shall meet 12 ksi minimum at 4 days and 18 ksi minimum at 28 days. Only a UHPC mix design that passes these tests may be used.

Pullout Test: Cast 6 additional cylinders 12 inch diameter and 7 ½ inches deep. Each cylinder shall have one 32 in. long epoxy-coated reinforcing bar cast in the center of the circular face. The axis of the bar shall be perpendicular to the formed surface. 3 of the bars shall be #6 bars embedded 5 inches deep and 3 of the bars shall be #4 bars embedded 3 inches deep. These cylinders will be kept wet for four days then delivered to the Materials Bureau for testing according to Test Method No. NY 701-14 E. Contact the Materials Bureau prior to casting for specific instructions on preparing the test specimens. The test will be performed as soon as practical after the corresponding samples reach 12 ksi.

EQUIPMENT FOR MATURITY TESTING:

Use a Maturity Meter and thermocouples that can:

- * Provide a maturity value based on the Equivalent Age or Temperature Time Method as detailed in ASTM C 1074-11.
- * Continuously log and store maturity data.
- * Accurate to within +/- 1° F when the meter is calibrated as per the manufacturer's instructions.
- * Take readings every half hour for the first 48 hours and every hour after that at a minimum.
- * Print data and/or download it into a spreadsheet.

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METHODOLOGY FOR MATURITY TESTING

The procedure for utilizing the maturity method to determine in-place UHPC strengths includes three steps: development of the strength-maturity relationship, monitoring the maturity of the placement, and regular validation of the strength maturity relationship. Any changes in the mix design, its components, or proportions will require that a new strength-maturity relationship be developed.

The strength-maturity relationship shall be developed one month prior to construction. Continue data collection for the strength-maturity relationship after acceptance of the maturity value until the strength reaches 18 ksi.

A procedure to develop the strength-maturity relationship shall be submitted to the DCES for review and approval along with the shop drawings. The submitted procedure shall include all necessary information for the development of the strength maturity relationship. All necessary testing included in the procedure shall be conducted by an AAHSTO accredited testing lab.

CONSTRUCTION DETAILS

DRAWINGS

Shop drawings and installation drawings shall be prepared and submitted as per the requirements of the Prestressed Concrete Construction Manual, (PCCM), and the following:

The submitted drawings shall include details of lifting and handling of panels in the production facility and their storage, transportation, handling and storage at the construction site. Lifting holes will not be permitted. The proposed handling and lifting shall be such that the maximum tensile stress in concrete for handling and erection loads when analyzed according to the proposed handling and installation procedures, shall not exceed $0.15 (f'ci)^{1/2}$, where $f'ci$ is the concrete compressive strength in ksi at the time being considered. Calculations showing actual concrete stresses based upon the proposed support locations and expected dynamic loading of the panels during handling, storage and transportation of the panels shall be prepared by a Professional Engineer and shall be submitted along with the drawings. These drawings and calculations shall be stamped and signed by a Professional Engineer.

The proposed method of mixing, placing, and curing the UHPC joints shall be shown on the drawings. The Contractor shall perform qualification testing as shown on the installation drawing to demonstrate that the proposed method will achieve the required strength at the required time.

FABRICATION

Fabrication shall meet the requirements of the PCCM and the following:

Fabrication Tolerances

1. Width (transverse direction of the bridge): +1/8" , -1/8"
2. Length (longitudinal direction of the bridge): +1/8" , -1/8"
3. Depth (overall): +1/8" , -0
4. Bulkhead alignment (deviation from square or designated skew)
 - Vertical +1/8"
 - Horizontal +1/8"
5. Horizontal alignment (deviation from straight line parallel to centerline of unit):
 - 3/16" for up to 40' length
 - 1/4" for 40' to 60' length
 - 5/16" for greater than 60' length

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Welding of steel shall comply with the requirements of the New York State Steel Construction Manual.

Placing Concrete, Curing and Finishing

All requirements stipulated in PCCM shall apply except for the following:

After curing, all form release material and all other forming material adhering to the shear keyway and block out concrete shall be removed. Shear key faces shall be roughened and blast cleaned such that the aggregate becomes exposed.

Shipping and Handling of Precast Panels. Shall be as per approved drawings.

Steel Embedments. Steel embedments for the panel leveling devices and hold down devices shall be installed in the shop based upon the locations shown on the shop drawings.

Loading of Panels. Equipment shall not be permitted on the precast units between the initial set of the UHPC and the time the UHPC has reached a minimum strength of 10 ksi.

Mixing and Placing UHPC Joints and Haunches. Specifications in the PCCM and the following:

Thoroughly wet the concrete contact area 24 hours prior the placing of UHPC, keep wet and remove all surface water just prior to UHPC placement.

INSTALLATION REQUIREMENTS FOR DECK SLABS

Installation shall meet the requirements of the PCCM and the following:

1. Prior to installing panels, the supporting steel surfaces in contact with the panels or field placed concrete shall be cleaned, including removal of free water, to the satisfaction of the Engineer.
2. Installation tolerances shall be as per the approved installation drawings. It is the responsibility of the Contractor to develop appropriate controls during the fabrication and installation of the panels so that proper cross slopes and grades are achieved after the diamond grinding operation. Installation drawing shall show the details of the proposed controls.

The wearing surface shall be diamond ground per section 505 after the closure pour has gained strength.

INSTALLATION REQUIREMENTS FOR APPROACH SLABS

Bed and level slabs in accordance with the system designer's instructions such that the vertical differential across any joint is ¼ in. or less. Slabs shall be placed on grade and have grout pumped underneath to ensure that they are completely supported.

The wearing surface shall be diamond ground per section 505 after the closure pour has gained strength.

Pre-Pour Meeting: Prior to the initial placement of the UHPC, the contractor shall arrange for an on site meeting with the UHPC representative. The contractor's staff and the NYSDOT Engineer

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and Inspectors shall attend the site meeting. The objective of the meeting will be to clearly outline the procedures for mixing, transporting, finishing and curing of the UHPC material.

The contractor shall arrange for a representative of the UHPC supplier to be on site during the placement of the joints until the Contractor's own staff has become well-trained in the use of the material. The representative shall be knowledgeable in the supply, mixing, delivery, placement, and curing of the UHPC material.

Storage: The contractor shall assure the proper storage of premix, fibers and additives as required by the supplier's specifications in order to protect materials against loss of physical and mechanical properties.

Form Work, Batching and Curing

The design and fabrication of forms shall follow approved installation drawings and shall follow the recommendations of the manufacturer. The forms shall be coated to prevent absorption of water.

The contractor shall follow the batching sequence as specified by the supplier and approved by the DCES. The surface of the UHPC field joints shall be filled flush with the precast panels to within a tolerance of + 1/16", - 0.

The UHPC in the form shall be cured according to Manufacturer's recommendations to attain the required strength shown on the contract documents.

Quality Control

The contractor shall measure the slump flow on each batch of UHPC. The slump flow will be conducted using a mini-slump cone. The flow for each batch shall be between 7 in. and 10 in. The slump flow for each batch shall be recorded in the QA/QC log. A copy of the log shall be given to the Engineer.

Estimation of In-Place Strength:

1. Two thermocouples per each UHPC joint, one at each end, shall be installed. The locations of these installations shall be shown on the installation drawings. These locations shall be revised if directed by the DCES. The thermocouple wiring may be connected to reinforcing steel, but probe endings may not be in direct contact with the steel. Consider structural or exposure conditions when placing thermocouples.
2. Listed actions are allowed when the maturity value of all the thermocouples reaches the corresponding strength values listed below.

Action	Strength Requirement
Removal of top forms	10 ksi
Open Bridge deck to Traffic	12 ksi

3. Record and save the maturity data from the meter until the strength reaches 18 ksi.

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Disconnect the meter and clip all wires flush with the concrete surface.

A continuous read thermocouple or thermistor with a data logger can be used to estimate in place strength. The methodology outlined in ASTM C 1074-11 will be used. The maturity function used to estimate strength will be calculated with the same formula that is used by the maturity meter that established the initial strength maturity relationship. Copies of the calculations will be provided to the Engineer.

Validation of the Strength-Maturity Relationship:

For each day of placement, perform validation tests by casting 7 cylinders. Equip one of the cylinders with a thermocouple. Test the cylinders as close as possible to the maturity value corresponding to 18 ksi. Record the maturity value immediately prior to testing. All testing shall be conducted by an AASHTO accredited testing lab. Report the results to the DCES.

If the average value of compressive strength of each pair of cylinders is within 10% of the estimated value, the strength-maturity relationship will be validated. If the average cylinder value is more than 10% below the estimated value, the strength maturity relationship will need to be re-established. If the first four cylinders produce acceptable results, the remainder need not be tested.

The Department may perform additional testing for research purposes. Casting and testing in addition to that required in this spec will be performed by NYSDOT personnel.

In case of loss of required data, or non-verification of the strength-maturity relationship, use the cylinders cast above, one pair at a time, to verify the strength.

DIAMOND GRINDING: Diamond grind per §505.

Watertight Integrity Test

After the joint has reached the required strength and after diamond grinding, a watertight integrity test may be performed in accordance with §567-3.01.H. If leakage does not occur the Contractor need not seal the joint. Rain which falls in sufficient quantity and over sufficient time to meet the requirement of §567-3.01.H is acceptable for performing the test.

Sealing the Joint

Abrasive blast clean the area to be treated, removing all contaminants from the surface. Clean adjacent surfaces of the leaking joints using compressed air which is free of oil and moisture.

Do not apply sealer if rain is expected within 12 hours of completion. Apply sealer to clean, dry surfaces when the surface temperature is at least 50° F, and if near 50° F, rising. The sealer shall be mixed and applied according to the manufacturer's instructions and no more than 5 gallons at a time. Pour the sealer over the joints.

When the methacrylate surface will be used as a driving surface, sand must be applied to provide friction. After the resin has been applied, at least 20 minutes shall elapse before applying the sand. The sand shall be broadcast at a rate of approximately two pounds per square yard, completely covering the sealer.

The sealer must be tack-free before construction traffic is permitted to resume.

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METHOD OF MEASUREMENT Apply all the provisions of §557-4.

BASIS OF PAYMENT Apply all the provisions of §557-5.

Payment will be made under:

<u>Item No.</u>	<u>Description</u>	<u>Pay Unit</u>
557.6301XX08	HPIC CONCRETE FOR SUPERSTRUCTURE SLABS - BOTTOM FORMWORK REQUIRED OR PRECAST SLAB ALTERNATE - TYPE XX FRICTION	Sq. Yards
557.6302XX08	HPIC CONCRETE FOR SUPERSTRUCTURE SLABS - BOTTOM FORMWORK NOT REQUIRED OR PRECAST SLAB ALTERNATE - TYPE XX FRICTION	Sq. Yards
557.6303XX08	HPIC CONCRETE FOR STRUCTURAL APPROACH SLAB OR PRECAST SLAB ALTERNATE - TYPE XX FRICTION	Sq. Yards

Where XX = 01, 02, 03, 09